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ABSTRACT

A 32-item survey was developed from the 1983 International Science Study and was administered to 299 gifted South Dakota sixth-tenth graders to measure their perceptions of science. A factor analysis of the data yielded four factors, accounting for 51% of the variance. The factors were: (1) Science as a Personal and National Priority; (2) Science as It Is Taught in the Public Secondary School; (3) Challenge of Science and School; and (4) School Is Unfullfilling. Results indicate that these students perceive science as a national priority. Science makes the world a better place to live, improves our standard of living and the development of our country, and helps in solving everyday problems. These gifted students enjoy science as it is taught and enjoy their active participation role in learning. Science is a complex, yet challenging subject. School, in general, is not challenging. These students affirm that liking science and achieving in science are related. (Author)

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A FACTOR ANALYTIC STUDY OF ATTITUDES OF GIFTED SECONDARY STUDENTS TOWARD SCIENCE

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Abstract

A thirty-two item survey was developed from the 1987 International Science Study and was administered to 299 gifted South Dakota sixth-tenth graders to measure their perceptions of science. A factor analysis of the data yielded four factors, accounting for 51 % of the variance. The factors were (1) Science as a Personal and National Priority, (2) Science as it is Taught in the Public Secondary School, (3) Challenge of Science and School, and (4) School is Unfulfilling. Results indicate that these students perceive science as a national priority. Science makes the world a better place to live, improves our standard of living, development of our country, and helps in solving everyday problems. These gifted students enjoy science as it is taught and enjoy their active participation role in learning. Science is a complex, yet challenging subject. School, in general, is not challenging. These students affirm that living science and achieving in science are related.

Background

Science achievers who make good grades, like science. Willard Jacobson and Rodney Doran, United States research coordinators of the Second International Science Study (SISS 1983), reported that 200,000 American ninth graders showed a high correlation between liking science and achievement in science (Jacobson and Doran, 1986). Students in the study had a positive attitude about science, but were less optimistic about the expenditure of public money for science and scientific research. 72 percent of the students found school challenging. These students characterized science learning as textbook, lecture/discussion-oriented, with 60 percent having some laboratory experiences. Two percent of the students surveyed were interested in becoming science teachers. Only 6 percent of the college-bound seniors planned to enroll in education, contrasted to 22 percent who planned to enroll in business. SISS attitudes of students, grades 5, 9, and 12, about science and school, were further described in (Jacobson, Doran, et. al., 1986) and (Miller, 1986).

The Third Assessment of Science, conducted within the 1978 National Assesment of Educational Progress (NAEP, 1978), marked the beginning of effective assessment of student attitudes and perceptions of science and science teachers at the national level (Yager and Penick, 1986). A number of follow-up studies using the NAEP data have been conducted at the University of Iowa (Hermes & Yager, 1981; Yager & Bonnstetter, 1984; Yager & Yager, 1983, 1985; Vargas-Gomez & Yager, 1987). Robert Yager and associates reported comparisons between schools, sex, race, and age

groups in NAEP science attitude follow-up studies. The Jegede-Somaz and Yager study found that students in elementary science programs have a significantly more positive attitude toward science than those who were not in the program. The Yager and Yager study found student attitudes toward science to be negative with increasing grade level.

Ronald Simpson and Steve Oliver studied the attitudes of male and female students, grades six through ten (Simpson, 1985). Simpson and Oliver's work supported earlier findings. There is a steady decline in attitude toward science and motivation to achieve in science among adolescent students in grades six through ten. Their study showed white males with more positive attitudes toward science and female students more motivated to achieve in science, a more favorable result than earlier attitude studies. The Simpson/Oliver study concurs with earlier studies concerning students' perceptions of science as it is taught. Science courses commonly taught to adolescent students in most school systems do not produce individuals with positive attitudes toward science and do not produce students eager to continue taking science courses.

The purpose of this study was to identify South Dakota secondary gifted students' perceptions of science. By considering these high-achieving students' views, it may be possible to contribute to the understanding of attitudes toward science as perceived by some of the brightest students in our country. Considering the views of gifted students toward science may be valuable for those who are charged with reforming national goals in Science Education. There is considerable

literature pertaining to student attitudes about science. These investigators found no reported studies focusing on attitudes of gifted secondary students toward science.

Method

Willard J. Jacobson and Rodney L. Doran reported in *The Science Teacher*, May, 1986, that the 2000 American ninth graders in the 1983 International Science Study showed a high correlation between "liking science" and achievement in science. To consider how the South Dakota gifted secondary students in this study perceive science, their science teachers, and science in school, 32 of the 52 items that appeared in Jacobson's "What Do Our Ninth Graders Think of Science and School" were selected and administered.

The subjects were 299 sixth to tenth graders who attended the 1986 South Dakota Governor's Camp for the Gifted. Students who attended the camp were designated as gifted students by their home school district, according to Dr. Bruce Milne, Professor of Gifted Education at The University of South Dakota and camp director. The criteria by which home districts selected gifted students to attend the camp included grades, ability, teacher recommendation, and student interest in attending the camp.

Survey participants were above average in grade performance and were active in extracurricular school, church, and community activities. Thirty-two percent of the sixth to tenth grade gifted students in the survey chose

science as their favorite subject. Few disliked science. Most of the students were avid readers. The participants characterized themselves as "popular students," "able to get along with most peers" (Milne 1987). Descriptive data of the sample are provided in Table 1.

Insert Table 1 about here

Data Analysis

The SPSS-X (1985) Pearson Product Moment Correlation program was use to generate a 32 by 32 item intercorrelation matrix for the response data. A principal component analysis of this matrix, utilizing unities in the diagonal, yielded six factors with eight values greater than one. Cattell's SCREE test (1966) suggested the rotation of four factors. These factors accounted for 51.5 of the total variance. Both oblique and orthogonal rotations were performed. The oblique rotations were used to obtain a set of meaningful factors. Alpha internal consistency reliabilities were also determined. The minimum acceptable loadings of + or - .4 was used for interpreting the factors (Gorsuch 1983). All items except one loaded highly on only one factor. The one item that did not load on any of the factors was discarded.

A Kaiser-Meyer-Olkin measure of sampling adequacy (Kaiser 1974) was .92

TABLE 1

Gifted Students Self Descriptive Data

(Maine 1987)

School Performance	Above average in all areas	59.5 %
	Above average in most areas	35.1 %
Participation in School	Very active	61.2%
	Somewhat active	34.4%
	Activities	
Participation in Activities Other Than School	Very active	35.8%
	Somewhat active	48.5%
Favorite School Subject	Science	32.4%
	Math	31.8%
	Social studies	14.4%
Grade in Favorite Subject	Above average	97.0%
	Average	3.0%
Least Favorite School Subject	Science	6.0%
	Math	22.4%
Avid Reader	Yes	78.3%
	Somewhat	9.0%
Relationship With Schoolmates	Popular get along well	44.5%
	Not very popular get along well	32.1%

obtained. This indicates that the partial correlation between the items are small when the effects of the other items are removed. According to Kaiser (1974), large values close to 1 are needed to perform a factor analysis. In fact, he characterizes measures in the .9's as "marvelous" and measures below .5 as "unacceptable."

Results and Discussion

The attitudes of the gifted students toward science and school was represented in four factors in Table 2. An examination of the loadings making up the factors indicated that the loadings for each factor tended to be high. No items loaded on more than one factor.

Insert Table 2 about here

Factor 1 reflected the student view of science as a national priority. The content of the items defining the factor suggested that gifted secondary students perceive science as a national priority. Our country's development is enhanced by science. Science improves everyday life and our standard of living. Science will help make the world a better place in the future. Public funds are well spent on science. Our government should allocate more funds for scientific research. All citizens can benefit from a knowledge of science. Science is a useful subject for all students. Science is a positive career choice for gifted students.

TABLE 2

Items by Factor for Pooled Students Percentage Version

Scale Loading	Item
	Factor1: Scienceas a Personal and NationalPriority
64	Money spent on science is well worth spending
60	Science is useful for solving the problems of everyday life
58	Science is very important for a country s dievelopment
57	Scientific inventions have made the world too complex
57	Science will help to make the world a better place in the future
48	The government should spend more money on scientific research
45	I want as much education as I can get
45	It is important to know science in order to get a good job
45	I want to learn more about the world we live in
44	In the future most jobs will require a knowledge of science
43	If properly taught almost all students could learn science
43	Public money spent on science in the last few years has been used wisely
40	Science is a very good field for creative people to enter
	Factor2: Scienceas It isTaught
66	The teacher made science lessons interesting for me last year
63	The teacher did demonstrations to help explain science ideas
59	The science taught at school is interesting
58	The science teacher helped students who had difficulties with learning science
49	The teacher used our ideas and suggestions when planning science lessons last year
48	We did laboratory work as part of our science lessons last year
47	We did fieldwork outside the classrooom as part of our science lessons last year
	Factor3: Challenge of Science and School
71	Science is a difficult subject
57	There are too many facts to learn in science
54	I find school challenging
51	Scientific inventions have made the world too complex
52	The most enjoyable part of my like is the time I spend at school
45	I would like to become a science teacher when I leave school
42	Much of the anxiety in modern society is due to science
	Factor4: School is Unfullfilling
74	I am bored most of the time
71	School is not very enjoyable
59	I generally dislike my schoolwork

The following questions did not load under the factors

In my future career I would like to use the science I learned at school

Scientists are responsible for the way in which their discoveries are applied

The second factor concerned the students' perspective on science in the classroom. These gifted students have positive attitudes towards their science teachers and their science classes. Science lessons are interesting. Science teachers provide demonstrations, laboratory work, and fieldwork outside the classroom. Gifted students contribute ideas for science lessons which teachers used in planning classwork. At the same time, all students are given help in learning science. These students perceive themselves as involved learners, in and outside of the classroom, and praise their teachers for providing the interesting environment.

Challenges and anxieties of science are addressed in Factor 3. Science is a challenging and anxiety-provoking subject, according to the gifted students. Science is a hard school subject, with too many facts to learn. Science inventions have made the world too complex and produces much anxiety in today's world. Some parts of school are challenging, but at the same time are the most enjoyable parts of daily life as a teenager. Science is challenging. In fact, many gifted students consider becoming a science teacher as a career goal.

The fourth factor concerns the general dissatisfaction with school. Although science rates as a challenging, interesting subject in school, these gifted students view school and classes with general dissatisfaction in Factor 4. Gifted students are adamant. School is boring. School is usually not enjoyable. Gifted students generally dislike schoolwork.

The correlation matrix for the factors, number of items and their alpha reliabilities are given in Table 3. The correlation between Factor 1

Science as a National Priority, and Factor 2, Science in the Classroom, is .151. This correlation suggests that the gifted students who perceived science as having instrumental value in their lives also actively participated in the science class and laboratory.

Insert Table 3 about here

The number of items and the alpha internal consistency reliabilities for each derived factor are also given in Table 3. The first three factors exhibited adequate reliability estimates to warrant their use in evaluating gifted secondary students' attitudes toward science. Items should be added to the scale of the fourth factor to enhance its reliability.

Summary

The tenor of priorities of the gifted students surveyed is positive. They reflect an active, responsible image of themselves in the future. Gifted students' concern for the improvement of society through science and broad view of "their world" as future citizens is optimistic. They show concern for the everyday usefulness of science for all people. They rate general education and knowledge of science as a worthwhile endeavor for their own career goals. They like challenging subjects such as science. Even though they view science as having too many facts to learn, these gifted students consider becoming a science teacher a career option.

TABLE 3

Factor Intercorrelation Matrix and their Alpha Reliabilities

	Factor Correlation Matrix				Number of	Alpha
	1	2	3	4	Items	Reliabilities
Factor 1	1.00				14	.99
Factor 2	0.51	1.00			7	.81
Factor 3	0.31	0.36	1.00		7	.74
Factor 4	0.26	0.18	0.26	1.00	3	.55

Although scientific inventions have added to the complexity of the world and to anxiety in modern society, they look for challenge in school subjects, not simplicity.

According to these gifted students, science teachers are doing a good job. Science classes are motivating to students. Teachers help all students learn through active student involvement, demonstrations, laboratories, and fieldwork. Gifted students are encouraged to contribute ideas and suggestions for classroom planning. The contrast is strong, however, between how motivated and challenged gifted students can be by difficult subjects such as science, and how dissatisfied they feel about the boredom of school. Gifted students look for school subjects that are meaningful to them now or as adults. Gifted students seek challenge and involvement in school subjects. Worthwhile subjects, such as science, should receive national priority support and funding.

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